

REMARKS

The office action of May 25, 2005 has been reviewed and its contents carefully noted. Reconsideration of this case, as amended, is requested. Claims 1-7, 9-13, and 22-24 remain in this case, claims 8 and 14-21 being cancelled, claim 24 being added and claims 1, 6, 9, 10, and 22 being amended by this response. No new matter has been entered.

Claims 1, 10, and 22 were amended to clarify the subject matter being claimed, no new matter has been entered. Support for the amendments made are found on page 4, lines 10, 16-17 of the specification and originally filed claim 8. Claims 6 and 19 were amended to fix typographical errors.

Exhibits B and C are enclosed with this response.

The numbered paragraphs below correspond to the numbered paragraphs in the Office Action.

Rejection(s) under 35 U.S.C. §103

3. Claims 1-23 were rejected under 35 U.S.C. 103(a) as being unpatentable over Kosco (USPN 6,338,747) in view of Baran et al. ("Silicon Containing High Performance Alloys Machinability and Mechanical Properties") and Graupner et al. (USPN 6,134,786) and Kempe et al. (USPN 6,213,177). Applicant respectfully disagrees.

Since the Examiner is not specific in his rejection regarding which claims are being discussed, Applicant will attempt to address the rejection as best understood by the Applicant in order to further prosecution. If the Applicant is wrong in their assumptions, Applicant would appreciate clarification.

In Kosco, a metallurgic powder is compacted at a pressure between 20 to 70 tsi, heated to 2000°F to 2400°F for 15 to 120 minutes, and then cooled at a rate no greater than 60°F per minute to room temperature, to ensure that the compact may sufficiently mechanically worked. Then, the compact is deformed to increase the density. After the densification step, the compact is heated again to 2050°F-2400°F and cooled at a rate of 160°F - 400°F/min to room

temperature. A secondary operation of tempering may follow. The densification in Kosco increases the surface density of a portion of the part by mechanical working.

The Examiner states in the present office action dated May 25, 2005, "Kosco further discloses wherein the forming a densified portion includes hot forming at a temperature of 1800°F for 3 minutes (see Example 2), in the temperature limitation of Applicant's step d) but for less time. The Examiner finding that the time limitation of a small part such as a race would lead to total heating of the part, resulting in the same desired effects as claimed."

Referring to Applicant's amended claim 1, step d) refers to "cooling the compact at a rate of 10°F to 120°F to ambient temperature" and is not related to hot forming the compact. Applicant asks the Examiner for clarification as to whether the Examiner was referring to a different step in Applicant's claim 1. Furthermore, the example is specific to densification, Applicant's amended claim 1 states "without substantial densification" (emphasis added) and therefore Example 2 of Kosco, as well as the whole of Kosco teaches away from Applicant's invention.

The Examiner also states that "Kosco thus differs from the claimed invention by the alloy additions and the full range of various temperature treatments" and that "Kosco further discloses heating parameters selected for the same purposes as disclosed by Applicant, and would be modified by one of ordinary skill based on the selection of the initial starting alloy in order to achieve the same utility as the disclosed invention." Applicant respectfully disagrees with the Examiner's statements. As shown in Applicants amended claim 1, the difference between Kosco and Applicant's invention regarding temperature ranges and treatments are significant. In Kosco, the compact is heated to 2000°F to 2400°F for 25 to 30 minutes, where Applicant's method as stated in amended claims 1 requires the compact to be heated within a range of temperatures, 1400°F to 2000°F, the starting temperature of the range is below Kosco's range and Applicant's ending temperature ends where Kosco's temperature range must begin.

Baran et al. discusses the advantages of including silicon in metal powder to increase hardenability, elongation, and tensile strength. Applicant's powder composition is not present in claim 1, but in dependent claim 12. Therefore, Baran et al. is only relevant to dependent claim 12 and not claim 1. Applicant believes claim 1 is now allowable and that claim 12 should also be

allowable for that reason, as well as for the additional recitations it contains. Reconsideration and withdrawal of the rejection is respectfully requested.

The Examiner acknowledges that, "Kosco '747 is silent to grinding as a working step." Graupner et al. does not teach or provide what Kosco lacks. Graupner et al. discloses a method to "overcome the limitations of misalignment between gear teeth and, misalignment between gear teeth and the gear centerline, or lead line error, ...avoids the requirement for honing and undercutting the root area between adjacent gear teeth... the gears are regenerated by skiving the gear after heat treatment to realign the gear teeth with each other and the gear centerline, to overcome misalignment and lead line error" (col. 3, lines 8-18). "This process serves to skive or remove extremely thin layers of material on the involute surfaces of gear teeth to thereby regenerate tooth surfaces" (col. 5-6, lines 60-3). The small amount of material removed from the gear teeth is 0.005 to 0.007 inches and the material is removed without contacting the root or undercutting the root of the gear teeth (col. 6, lines 13-18).

In col. 5, lines 2-6 of Graupner, in which the Examiner points to states, "[d]uring the manufacture of gears, it is known that gear teeth can become misaligned relative to each other and to center line of gear. Therefore, gears are frequently regenerated on grinding machines after heat treating to regenerate gear teeth relationships" and is about regenerating the gear teeth to fix certain teeth relationships and does not say anything about producing a profile with detailed geometry. Referring to enclosed Exhibit B, the machining or grinding used in Applicant's invention and the grinding used in Graupner et al. is shown. Applicant starts off with a cross-section of a sprocket that only has a whole row of teeth as shown in Exhibit C. After profile or form grinding has taken place, profiles and detailed geometry, such as multiple rows of teeth, an undercut, and other complex shapes may be made. The shapes are not limited to those shown in the Exhibit. The Applicant removes a significantly greater amount of material than in the prior art, including Graupner et al., as shown in Exhibits Band C. Graupner et al. starts with teeth already present and their profile is indicated by the solid line. After grinding has occurred, shown by the dashed line, only 0.005 to 0.007 inches on the involute surfaces of the gear teeth has been removed. Furthermore, since grinding only occurs on the involute surfaces of the teeth, a profile with detailed surface geometry could not be formed as stated in the amended claim and is taught against. The grinding in Graupner et al. corrects or reduces misalignment between gear teeth,

adjacent gear teeth flanks and to reduce lead line error of the gear and does not "produce a profile with detailed geometry" as stated in Applicant's amended claim 1. Moreover, heat treatment and hardening of the gear occur prior to skiving or regenerating the gear teeth in Graupner, while according to Applicant's amended claim 1, machining or grinding to produce a profile with detailed geometry occurs prior to heat treatment and hardening as conducted in steps f and g.

Kempe et al. discloses a feed wheel for use in a wood working machine. Kempe et al. is not specific about how the wheel is formed and only discusses the best way to configure the teeth of the wheel "in order to facilitate efficient driving of [a] wood piece" (col. 3, lines 37-39). Applicant is not claiming to have invented gear geometry, instead Applicant is claiming a method of producing sprockets using powdered metal. Kempe et al. is silent as to grinding and does not provide what Kosco or Graupner et al. lacks.

The combination of Kosco in view of Baran et al. and Graupner and Kempe et al. would result in a metallurgic powder containing silicon that is compacted between 20 to 70 tsi, heated to 2000°F to 2400°F for 15 to 120 minutes, and then cooled at a rate no greater than 60°F per minute to room temperature to prepare the compact for surface densification. Then, the compact is deformed to increase the density. After densification, the compact is heated again to 2050°F-2400°F and cooled at a rate of 160°F - 400°F/min to room temperature, with a secondary operation of tempering. After the part is quenched and then tempered, grinding is performed to correct or reduce misalignment between gear teeth, adjacent gear teeth flanks and to reduce lead line error of the gear, only removing 0.005 to 0.007 inches. The teeth of the sprocket may have gear geometry that facilitates the efficient driving of a wood piece.

The combination does not result in Applicant's invention. Applicant's amended claim 1 states, "A method of producing parts from powdered metal comprising the steps of:

"a) providing a metallurgic powder;

"b) compressing the metallurgic powder at a pressure of 30 to 65 tons per square inch to provide a compact;

"c) heating the compact to 1400 °F to 2000 °F for 20 to 60 minutes;

"d) cooling the compact at a rate of 10 °F to 120 °F per minute to ambient temperature;

"e) machining or grinding the compact to produce a profile with detailed surface geometry without substantial densification;

"f) heating the compact to 2000 °F to 2400 °F for 20 to 80 minutes;

"g) cooling the compact at a rate of 120 °F to 450 °F per minute; and

"h) heating the compact to 300 °F to 1000 °F for 30 to 90 minutes.

The combination fails to teach or suggest "heating the compact to 1400 °F to 2000 °F for 20 to 60 minutes," and "machining or grinding the compact to produce a profile with detailed surface geometry without substantial densification" prior to heat treatment and hardening (emphasis added).

With regards to the rejection of claim 10, Kosco discloses a metallurgic powder that is compacted at a pressure between 20 to 70 tsi, heated to 2000°F to 2400°F for 15 to 120 minutes, and then cooled at a rate no greater than 60°F per minute to room temperature, to ensure that the compact may sufficiently mechanically worked. Then, the compact is deformed to increase the density. After the densification step, the compact is heated again to 2050°F-2400°F and cooled at a rate of 160°F - 400°F/min to room temperature. A secondary operation of tempering may follow. The densification in Kosco increases the surface density of a portion of the part by mechanical working.

The Examiner states in the present office action dated May 25, 2005, "Kosco further discloses wherein the forming a densified portion includes hot forming at a temperature of 1800°F for 3 minutes (see Example 2), in the temperature limitation of Applicant's step d) but for less time. The Examiner finding that the time limitation of a small part such as a race would lead to total heating of the part, resulting in the same desired effects as claimed."

Referring to Applicant's amended claim 10, step d) refers to "cooling the compact at a rate of 25°F to ambient temperature" and is not related to hot forming the compact. Applicant

asks the Examiner for clarification as to whether the Examiner was referring to a different step in Applicant's claim 10.

The Examiner also states that "Kosco thus differs from the claimed invention by the alloy additions and the full range of various temperature treatments" and that "Kosco further discloses heating parameters selected for the same purposes as disclosed by Applicant, and would be modified by one of ordinary skill based on the selection of the initial starting alloy in order to achieve the same utility as the disclosed invention." Applicant respectfully disagrees with the Examiner's statements. As shown in Applicants amended claim 10, the difference between Kosco and Applicant's invention regarding temperature ranges and treatments are significant. In Kosco, the compact is heated to 2000°F to 2400°F for 25 to 30 minutes, where Applicant's method as stated in amended claim 10 requires the compact to be heated 1650°F, far below the range of Kosco.

Baran et al. discusses the advantages of including silicon in powder metal powder to increase hardenability, elongation, and tensile strength. Silicon is not present in Applicant's claim 10 or in dependent claim 13 and Applicant respectfully requests reconsideration and withdrawal of the reference from the rejection.

The Examiner acknowledges that, "Kosco '747 is silent to grinding as a working step." Graupner et al. does not teach or provide what Kosco lacks. Graupner et al. discloses a method to "overcome the limitations of misalignment between gear teeth and, misalignment between gear teeth and the gear centerline, or lead line error, ...avoids the requirement for honing and undercutting the root area between adjacent gear teeth... the gears are regenerated by skiving the gear after heat treatment to realign the gear teeth with each other and the gear centerline, to overcome misalignment and lead line error" (col. 3, lines 8-18). "This process serves to skive or remove extremely thin layers of material on the involute surfaces of gear teeth to thereby regenerate tooth surfaces" (col. 5-6, lines 60-3). The small amount of material removed from the gear teeth is 0.005 to 0.007 inches and the material is removed without contacting the root or undercutting the root of the gear teeth (col. 6, lines 13-18).

In col. 5, lines 2-6 of Graupner, in which the Examiner points to states, "[d]uring the manufacture of gears, it is known that gear teeth can become misaligned relative to each other

and to center line of gear. Therefore, gears are frequently regenerated on grinding machines after heat treating to regenerate gear teeth relationships" and is about regenerating the gear teeth to fix certain teeth relationships and does not say anything about producing a profile produce a profile of two rows of teeth with groove in between the two rows. Referring to enclosed exhibit B, the grinding used in Applicant's invention and the grinding used in Graupner et al. is shown. Applicant starts off with a cross-section of a sprocket that only has a whole row of teeth as shown in Exhibit C. After profile or form grinding has taken place, profiles and detailed geometry, such as multiple rows of teeth, an undercut, and other complex shapes may be made. The shapes are not limited to those shown in the Exhibit. The Applicant removes a significantly greater amount of material than in the prior art, including Graupner et al. as shown in Exhibits B and C. Graupner et al. starts with teeth already present and their profile is indicated by the solid line. After grinding has occurred, shown by the dashed line, only 0.005 to 0.007 inches on the involute surfaces of the gear teeth has been removed. Furthermore, since grinding only occurs on the involute surfaces of the teeth, a profile with detailed surface geometry could not be formed as stated in the amended claim and is taught against. The grinding in Graupner et al. corrects or reduces misalignment between gear teeth, adjacent gear teeth flanks and to reduce lead line error of the gear and does not " produce a profile of two rows of teeth with a groove in between the two rows" as stated in Applicant's amended claim 10. Moreover, heat treatment and hardening of the gear occur prior to skiving or regenerating the gear teeth in Graupner, while according to Applicant's amended claim 10, machining or grinding the compact to produce a profile of two rows of teeth with a groove in between the two rows occurs prior to heat treatment and hardening as conducted in steps f and g.

Kempe et al. discloses a feed wheel for use in a wood working machine. Kempe et al. is not specific about how the wheel is formed and only discusses the best way to configure the teeth of the wheel "in order to facilitate efficient driving of [a] wood piece" (col. 3, lines 37-39). Applicant is not claiming to have invented gear geometry, instead Applicant is claiming a method of producing sprockets using powdered metal. Kempe et al. is silent as to grinding and does not provide what Kosco or Graupner et al. lacks.

The combination of Kosco in view of Baran et al. and Graupner and Kempe et al. would result in a metallurgic powder containing silicon that is compacted between 20 to 70 tsi, heated

to 2000°F to 2400°F for 15 to 120 minutes, and then cooled at a rate no greater than 60°F per minute to room temperature to prepare the compact for surface densification. Then, the compact is deformed to increase the density. After densification, the compact is heated again to 2050°F-2400°F and cooled at a rate of 160°F - 400°F/min to room temperature, with a secondary operation of tempering. After the part is quenched and then tempered, grinding is performed to correct or reduce misalignment between gear teeth, adjacent gear teeth flanks and to reduce lead line error of the gear, only removing 0.005 to 0.007 inches. The teeth of the sprocket may have gear geometry that facilitates the efficient driving of a wood piece.

The combination does not result in Applicant's invention as stated in amended claim 10.
"A method of producing parts from powdered metal comprising the steps of:

- "a) providing a metallurgic powder;
- "b) compressing the metallurgic powder at a pressure of 45 tons per square inch to provide a compact;
- "c) heating the compact to 1650 °F for 30 minutes;
- "d) cooling the compact at a rate of 25 °F per minute to ambient temperature;
- "e) machining or grinding the compact to produce a profile of two rows of teeth with a groove in between the two rows;
- "f) heating the compact to 2070 °F for 30 minutes;
- "g) cooling the compact at a rate of 150 °F per minute; and
- "h) heating the compact heating the compact to 300 °F to 1000 °F for 30 to 90 minutes."

The combination fails to teach or suggest "heating the compact to 1650 °F for 30 minutes," and "machining or grinding the compact to produce a profile of two rows of teeth with a groove in between the two rows" prior to heat treatment and hardening (emphasis added).

With regards to the rejection of claim 22, Kosco discloses a metallurgic powder that is compacted at a pressure between 20 to 70 tsi, heated to 2000°F to 2400°F for 15 to 120 minutes, and then cooled at a rate no greater than 60°F per minute to room temperature, to ensure that the compact may sufficiently mechanically worked. Then, the compact is deformed to increase the density. After the densification step, the compact is heated again to 2050°F-2400°F and cooled at a rate of 160°F - 400°F/min to room temperature. A secondary operation of tempering may follow. The densification in Kosco increases the surface density of a portion of the part by mechanical working.

The Examiner states in the present office action dated May 25, 2005, "Kosco further discloses wherein the forming a densified portion includes hot forming at a temperature of 1800°F for 3 minutes (see Example 2), in the temperature limitation of Applicant's step d) but for less time. The Examiner finding that the time limitation of a small part such as a race would lead to total heating of the part, resulting in the same desired effects as claimed."

Referring to Applicant's amended claim 22, step d) refers to "cooling the compact at a rate of 10°F to 120°F" and is not related to hot forming the compact. Applicant asks the Examiner for clarification as to whether the Examiner was referring to a different step in Applicant's claim 22. Furthermore, the example is specific to densification, Applicant's amended claim 22 states "without substantial densification" (emphasis added) and therefore Example 2 of Kosco, as well as the whole of Kosco teaches away from Applicant's invention.

The Examiner also states that "Kosco thus differs from the claimed invention by the alloy additions and the full range of various temperature treatments" and that "Kosco further discloses heating parameters selected for the same purposes as disclosed by Applicant, and would be modified by one of ordinary skill based on the selection of the initial starting alloy in order to achieve the same utility as the disclosed invention." Applicant respectfully disagrees with the Examiner's statements. As shown in Applicants amended claim 22, the difference between Kosco and Applicant's invention regarding temperature ranges and treatments are significant. In Kosco, the compact is heated to 2000°F to 2400°F for 25 to 30 minutes, where Applicant's method as stated in amended claim 22 requires the compact to be heated within a range of

temperatures, 1400°F to 2000°F, the starting temperature of the range is below Kosco's range and Applicant's ending temperature ends where Kosco's temperature range must begin.

Baran et al. discusses the advantages of including silicon in powder metal powder to increase hardenability, elongation, and tensile strength. Applicant's powder composition is not present in claim 22. Reconsideration and withdrawal of the reference from the rejection is respectfully requested.

The Examiner states that, "Kosco '747 is silent to grinding as a working step." Graupner et al. does not teach or provide what Kosco lacks. Graupner et al. discloses a method to "overcome the limitations of misalignment between gear teeth and, misalignment between gear teeth and the gear centerline, or lead line error, ...avoids the requirement for honing and undercutting the root area between adjacent gear teeth... the gears are regenerated by skiving the gear after heat treatment to realign the gear teeth with each other and the gear centerline, to overcome misalignment and lead line error" (col. 3, lines 8-18). "This process serves to skive or remove extremely thin layers of material on the involute surfaces of gear teeth to thereby regenerate tooth surfaces" (col. 5-6, lines 60-3). The small amount of material removed from the gear teeth is 0.005 to 0.007 inches and the material is removed without contacting the root or undercutting the root of the gear teeth (col. 6, lines 13-18).

In col. 5, lines 2-6 of Graupner, in which the Examiner points to states, "[d]uring the manufacture of gears, it is known that gear teeth can become misaligned relative to each other and to center line of gear. Therefore, gears are frequently regenerated on grinding machines after heat treating to regenerate gear teeth relationships" and is about regenerating the gear teeth to fix certain teeth relationships and does not say anything about producing a profile with detailed geometry of two rows of teeth with a groove in between the two rows. Referring to enclosed exhibit B, the grinding used in Applicant's invention and the grinding used in Graupner et al. is shown. Applicant starts off with a cross-section of a sprocket that only has a whole row of teeth as shown in Exhibit C. After profile or form grinding has taken place, profiles and detailed geometry, such as multiple rows of teeth, an undercut, and other complex shapes may be made. The shapes are not limited to those shown in the Exhibit. The Applicant removes a significantly greater amount of material than in the prior art, including Graupner et al., as shown in Exhibits B

and C. Graupner et al. starts with teeth already present and their profile is indicated by the solid line. After grinding has occurred, shown by the dashed line, only 0.005 to 0.007 inches on the involute surfaces of the gear teeth has been removed. Furthermore, since grinding only occurs on the involute surfaces of the teeth, a profile with detailed surface geometry of two rows of teeth with a groove in between the two rows could not be formed as stated in the amended claim and is taught against. The grinding in Graupner et al. corrects or reduces misalignment between gear teeth, adjacent gear teeth flanks and to reduce lead line error of the gear and does not "produce a profile with the detailed surface geometry of two rows of teeth with a groove in between the two rows " as stated in Applicant's amended claim 22. Moreover, heat treatment and hardening of the gear occur prior to skiving or regenerating the gear teeth in Graupner, while according to Applicant's amended claim 22, machining or grinding to produce a profile with detailed surface geometry of two rows of teeth with a groove in between the two rows occurs prior to heat treatment and hardening as conducted in steps f and g.

Kempe et al. discloses a feed wheel for use in a wood working machine. Kempe et al. is not specific about how the wheel is formed and only discusses the best way to configure the teeth of the wheel "in order to facilitate efficient driving of [a] wood piece" (col. 3, lines 37-39). Applicant is not claiming to have invented gear geometry, instead Applicant is claiming a method of producing sprockets using powdered metal. Kempe et al. is silent as to grinding and does not provide what Kosco or Graupner et al. lacks.

The combination of Kosco in view of Baran et al. and Graupner and Kempe et al. would result in a metallurgic powder containing silicon that is compacted between 20 to 70 tsi, heated to 2000°F to 2400°F for 15 to 120 minutes, and then cooled at a rate no greater than 60°F per minute to room temperature to prepare the compact for surface densification. Then, the compact is deformed to increase the density. After densification, the compact is heated again to 2050°F-2400°F and cooled at a rate of 160°F - 400°F/min to room temperature, with a secondary operation of tempering. After the part is quenched and then tempered, grinding is performed to correct or reduce misalignment between gear teeth, adjacent gear teeth flanks and to reduce lead line error of the gear, only removing 0.005 to 0.007 inches. The teeth of the sprocket may have gear geometry that facilitates the efficient driving of a wood piece.

The combination does not result in Applicant's amended claim 22, which states, "A sprocket with detailed surface geometry of two rows of teeth with a groove in between the two rows made by a method comprising the steps of:

- "a) providing a metallurgic powder;
- "b) compressing the metallurgic powder at a pressure of 30 to 65 tons per square inch to provide a compact;
- "c) heating the compact to 1400 °F to 2000 °F for 20 to 60 minutes;
- "d) cooling the compact at a rate of 10 °F to 120 °F per minute to ambient temperature;
- "e) grinding the compact to produce a profile with the detailed surface geometry of two rows of teeth with a groove in between the two rows without substantial densification;
- "f) heating the compact to 2000 °F to 2400 °F for 20 to 80 minutes;
- "g) cooling the compact at a rate of 120 °F to 450 °F per minute; and
- "h) heating the compact to 300 °F to 1000 °F for 30 to 90 minutes."

The combination fails to teach or suggest "heating the compact to 1400°F to 2000 °F for 20 to 60 minutes," and "grinding the compact to produce a profile with the detailed surface geometry of two rows of teeth with a groove in between the two rows without substantial densification" prior to heat treatment and hardening (emphasis added).

Therefore, it is respectfully suggested that the rejection of independent claims 1, 10, 14, and 22 as being anticipated by Kosco (USPN 6,338,747) in view of Baran et al. ("Silicon Containing High Performance Alloys Machinability and Mechanical Properties") and Graupner et al. (USPN 6,134,786) and Kempe et al. (USPN 6,213,177) is overcome. Dependent claims 2-9, 11-13, 15-21, 23, and 24 being dependent upon and further limiting independent claims 1, 10,

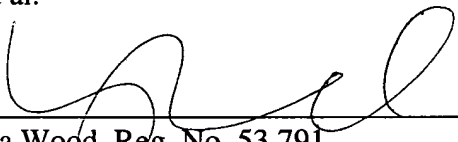
14, and 22, should also be allowable for that reason, as well as for the additional recitations they contain. Reconsideration and withdrawal of the rejection are respectfully requested.

Conclusion

Applicant believes the claims, as amended, are patentable over the prior art, and that this case is now in condition for allowance of all claims therein. Such action is thus respectfully requested. If the Examiner disagrees, or believes for any other reason that direct contact with Applicants' attorney would advance the prosecution of the case to finality, he is invited to telephone the undersigned at the number given below.

"Recognizing that Internet communications are not secured, I hereby authorize the PTO to communicate with me concerning any subject matter of this application by electronic mail. I understand that a copy of these communications will be made of record in the application file."

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Xu et al.

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